

Directional Surveys and Associated Issues

Keith May
Technical Permitting
Engineering Unit

Presentation Overview



Introduction
Survey Requirements
Submission Procedures
Engineering Review

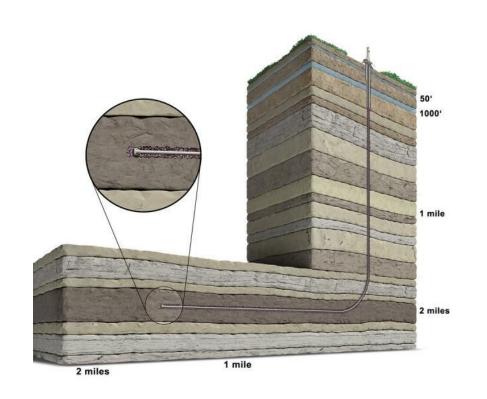
Presentation Overview

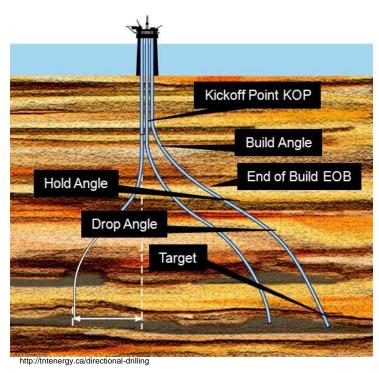


Introduction Survey Requirements Submission Procedures Engineering Review

Directional Drilling







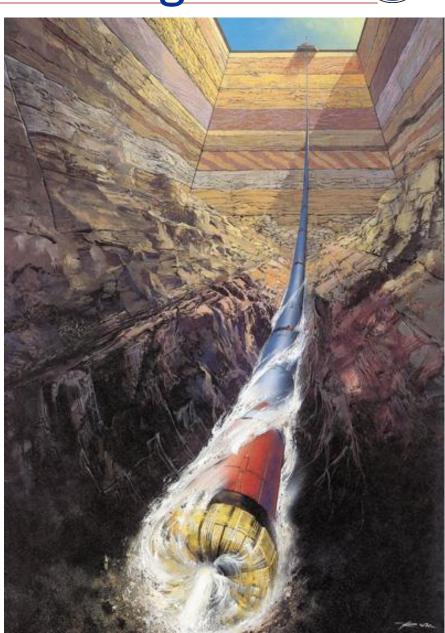
Thanks to advancements in drilling technology, drillers have incredible control and precision over their drilling operations.

Directional Drilling



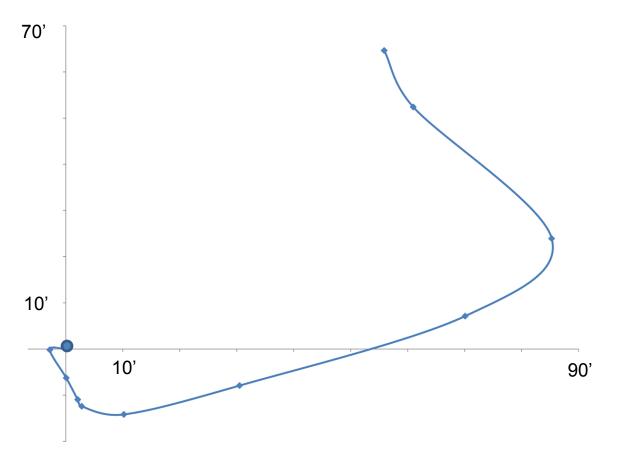
Measurement while drilling or MWD tools allow the driller to "steer" the drill bit.

After each joint of pipe is added positional data is transmitted up the wellbore. What we end up with is X, Y and Z coordinates of the wellbore.



Vertical Well



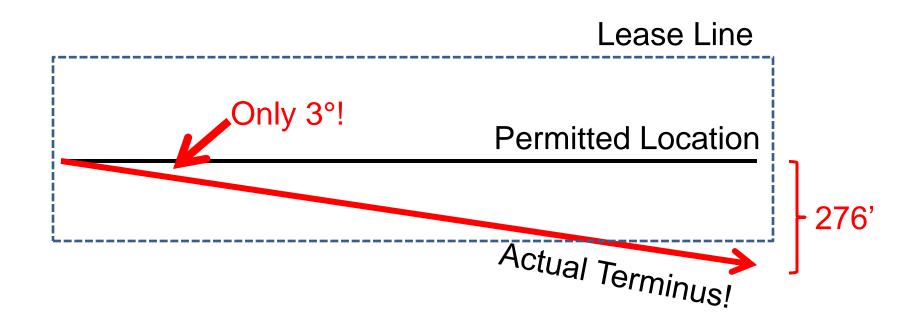


Even vertical wells can have substantial drifts from their intended direction.

An Example



Drilling a 5280' horizontal with 3 degree error in a particular direction would result in offset of 276' in that direction!



An Example



Drilling a 5280' horizontal with 3 degree error in a particular direction would result in offset of 276' in that direction!

- Typical horizontals in Eagle Ford are thousands of feet in length.
- Typical lease line spacing is 330'.
- Must be in compliance with spacing rules.

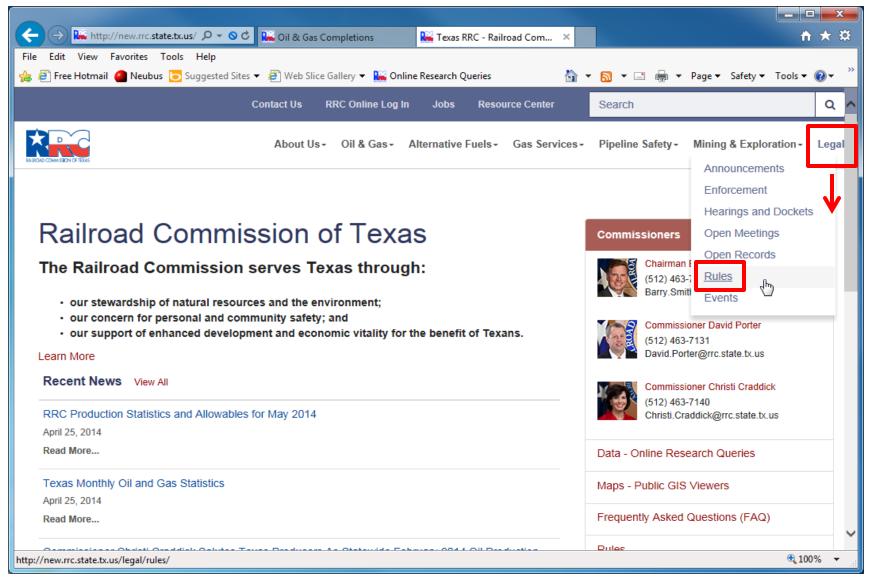
The RRC has a job to do



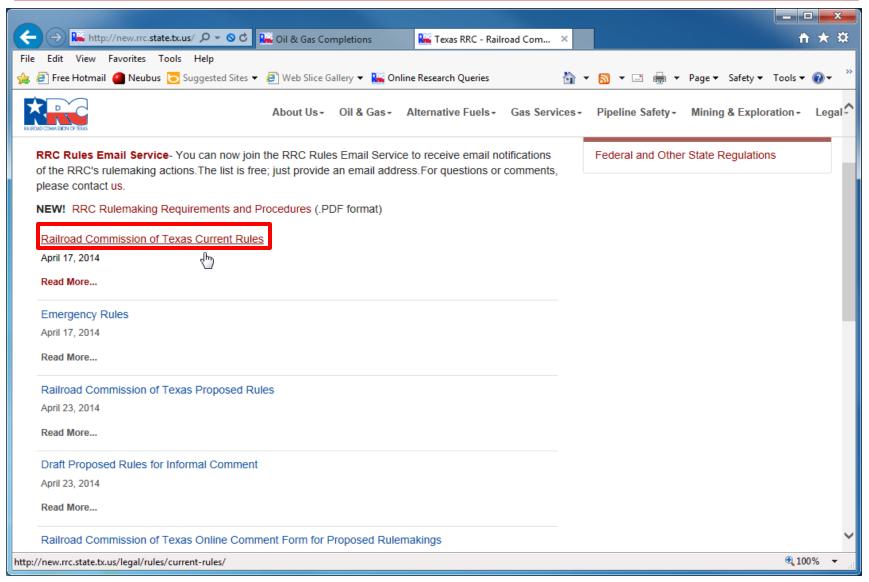
Why must surveys and inclination reports be submitted?

- To insure lease line and wellbore spacing rules are being followed.
- Protection of oil and gas reservoirs

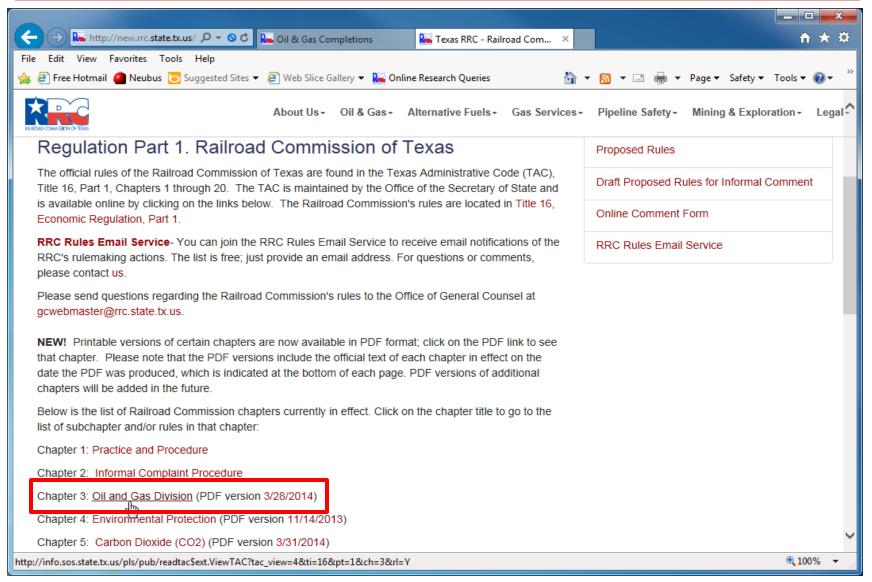




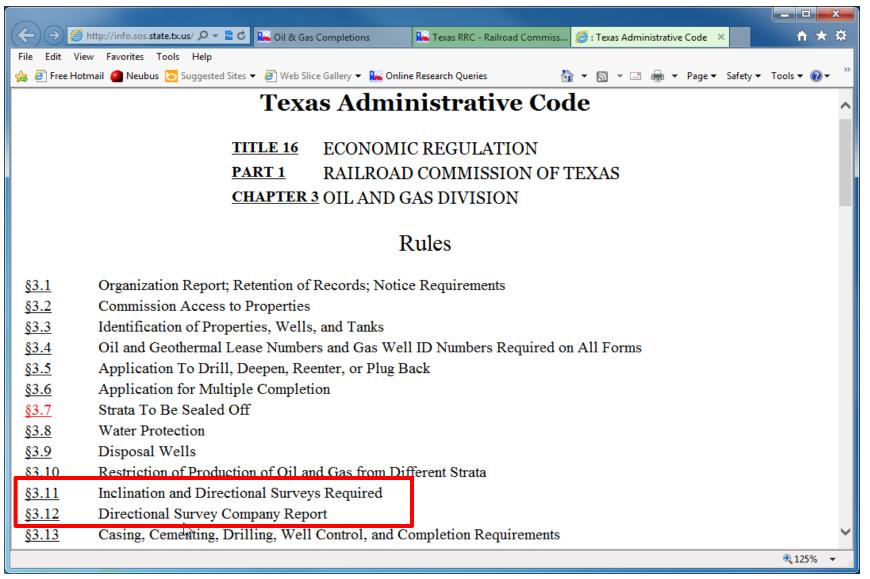












Presentation Overview



Introduction
Survey Requirements
Submission Procedures
Engineering Review

Presentation Overview



Introduction Survey Requirements Submission Procedures Engineering Review

Statewide Rule 3.11 (SWR 11)



SWR11 outlines the requirements for inclination and directional surveys

Purpose: to accurately confine well location in 3-D space (X, Y, Z)

Different survey combinations required depending on wellbore profile

Survey Types



Inclination surveys

Inclination and offset data only (Form W-12)
No coordinates or directional data

Directional surveys

Gyroscopic borehole survey (GYRO)

Measurement while drilling (MWD)

Provide coordinate data (X, Y, and Z)

Each survey type has different data and certification requirements. It pays to get it right the first time.

Statewide Rule 3.11 (SWR 11)



INCLINATION SURVEYS

Required of any well drilled/deepened with rotary tools

First data point shall not exceed 500' deep

Data points not to exceed 1000' apart

Outlines several exceptions to the rule based on depth and spacing to lease lines

Statewide Rule 3.11 (SWR 11)



INCLINATION SURVEYS

Submitted on form W-12 by operator

Performed by drilling company

Certified by drilling company and operator

Report horizontal offset without direction, so offset direction assumed to be toward nearest lease line

Form W-12



		RAILROAD COMMI		ıs	Form W-12 (1-1-71)
					73532705610700
	7. REC Lease Number. (Oil completions only)				
- FIELD HANE (**)	g. Well Number				
S. OPERATOR					9. RRC Mentification
J. OPERATOR	Number (Oes completions only				
4. ADDRESS					10. County
S. LOCATION (Section	In County				
		RECORD OF	INCLINATION		
11. Measured Depth	To do not been		ta. Displacement car	15. Course	16. Assumption
(feet)	(Stundreds of feet)	*13. Angle of Inclination* (Degrees)	Stundred Feet (Sine of Angle X100)	Displacement (feet)	Displacement (feet)
	+	-		-	
	-	-		-	_
	-			-	_
	-	-		-	
	+	_		_	+
17. In any informat	ion shown on the reven	reverse side of this forms se side of this form? ell bore at total depth of	- yes		fact.
19. Inclination mee	saurements were made i	a - 🖂 Tubing	Casing Casing	Open bole	Drill Pipe
		to the nearest lease lin			feet.
		scribed by field rules stionally deviated from th			
(If the answer	to the above question i	e "yee", ettech witten i	explanation of the circ	unstances.)	
INCLINATION DATA CERTIFICATION 1 declare unser practices prescribed in Sec. 91.143. Texas Natural Resources Code, that I am authorized to make this certification, that I have personal incomings or the intelligation data and facts glaced on both have personal incomings or the intelligation data and facts glaced on both pleis to the best of my horseinedge only destroy certific, and com- pleis to the best of my horseinedge. The decimal personal code is also all data as indicated by accreasing 10 years to the form. at 11 data as			OPERATOR CERTIFICATION I declare under peratitive prescripted in Sec. 93.143, Team Nature Francisco Code, that I am authorized to make this conditionation, that that all data presented on both sides of this from are true, covers; an complete to the best of my knowledge. This certification covers all size and information presented herein except inclination data as indicated by arterists (7) by the term embesses on this form.		
Signature of Authoriz		See a se	Signature of Authoria		
Name of Person and					
	Time ((the so boss)		Name of Person and Title (type or print) Operator		
Name of Company Telephone: Area Co			Telephone: Area Code		

Form W-12



RECORD OF INCLINATION

*11. Measured Depth (feet)	12. Course Length (Hundreds of feet)	*13. Angle of Inclination (Degrees)	14. Displacement per Hundred Feet (Sine of Angle X100)	15. Course Displacement (feet)	16. Accumulative Displacement (feet)
		,			
					100
	,				
The second second					
			, ,		

Shows cumulative displacement from vertical. Must not exceed distance to nearest lease line

Form W-12

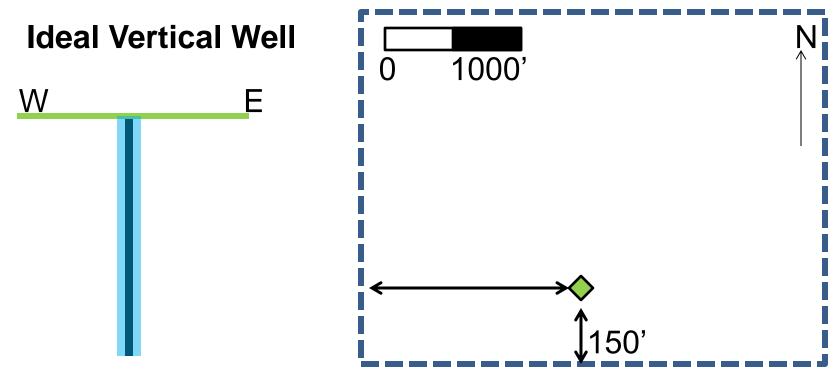


If additional space is needed, use the reverse side of this form.							
17. Is any information shown on the reverse side of this form?	yes no	<u> </u>					
18. Accumulative total displacement of well bore at total depth of	feet =	feet.					
*19. Inclination measurements were made in - Tubing	Casing Open hole	Drill Pipe					
20. Distance from surface location of well to the nearest lease line		feet.					
21. Minimum distance to lease line as prescribed by field rules		feet.					
22. Was the subject well at any time intentionally deviated from the vertical in any manner whatsoever?							
(If the answer to the above question is "yes", attach written explanation of the circumstances.)							
I declare under penalties prescribed in Sec. 91.143, Texas Natural Resources Code, that I am authorized to make this certification, that I have personal knowledge of the inclination data and facts placed on both sides of this form and that such data and facts are true, correct, and complete to the best of my knowledge. This certification covers all data as indicated by asterisks (*) by the item numbers on this form.							
Signature of Authorized Representative	Signature of Authorized Representat	ive					
Name of Person and Title (type or print)	Name of Person and Title (type or pr	rint)					
Name of Company	Operator						
Telephone:	Telephone:						

Operator certifies that the well was not intentionally deviated from vertical.

SWR 11: Vertical Wells



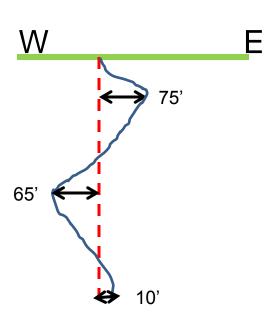


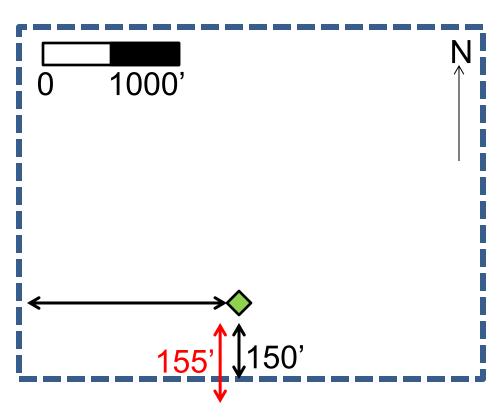
W-12 accepted for entire depth

SWR 11: Vertical Wells



Actual Well





Cumulative total displacement: 75'+65'+10'=155'

Actual displacement: 10'

SWR 11: Directional Surveys



DIRECTIONAL SURVEYS

Required for any intentionally-deviated well

Data points no more than 200' apart, *beginning within 200' of the surface

May begin immediately below surface casing depth (W-12 required in this case)

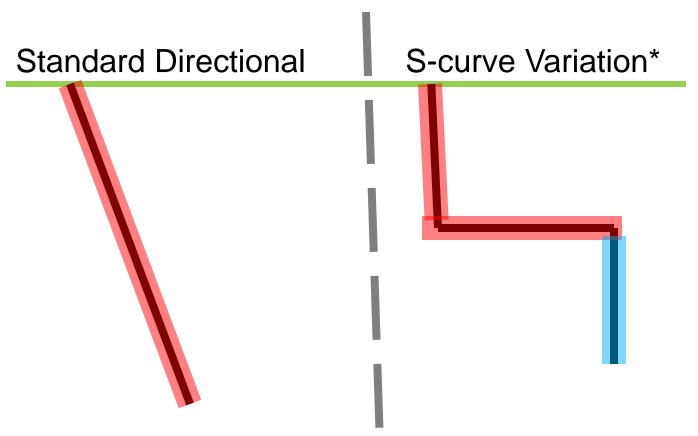
SWR 86: Horizontal Wells





SWR 11: Directional Wells





Directional Survey Required *Special permission required **Inclination Survey Accepted**

to drill an S-curve

Statewide Rule 3.86 (SWR 86)



SWR 86 outlines requirements for Horizontal Drainhole Wells

Purpose: to establish standard requirements for horizontal wells

Directional surveys required

SWRs 11 & 86: Surveys



- Common mistakes:
 - WRONG SURVEYS for wellbore profile
 - Surveys missing completely
 - Surveys lacking certification
 - Surveys don't tie-in
 - Surveys attached for wrong well
- Solution:
 - Survey company must correct and resubmit

Statewide Rule 3.12 (SWR 12)



Outlines requirements for Submission and Certification of Directional Surveys:

- Survey Company Name
- Name and title of individual performing survey
- Date survey was performed
- Type of survey conducted
- Complete well identification
- Depths surveyed
- Drilling permit plat with bottom hole location.

SWR 12: Proper Certification



I, *name*, an authorized employee of THE SURVEY COMPANY, have verified the GYRO/MWD survey performed on 04/01/2013 to 04/02/2013, from 200' to 15000'. The data are true, correct, complete and within the limitations of the tool. This survey was conducted at the request of OPERATOR for LEASE WELL# (API#) drilled in TRAVIS COUNTY, Texas.

SWR 12: Directional Surveys



Directional Surveys must be submitted and certified by the company that performed the survey.

They cannot be accepted directly from the operator.

SWR 12: Proper Certification



Common mistakes:

- Uploading cover letter instead
- Double-certifying another company's interval
- Certification completely missing

Solution:

Survey company must correct and resubmit

Presentation Overview



Introduction
Survey Requirements
Submission Procedures
Engineering Review

Presentation Overview



Introduction
Survey Requirements
Submission Procedures
Engineering Review

Submission Procedures



Submission of Directional surveys is the responsibility of the survey company.

Survey companies:

- Must appear on list of approved survey companies*
- Must have active P-5 (Organization Report)
- Must upload certification letter as a separate file

Submission Procedures

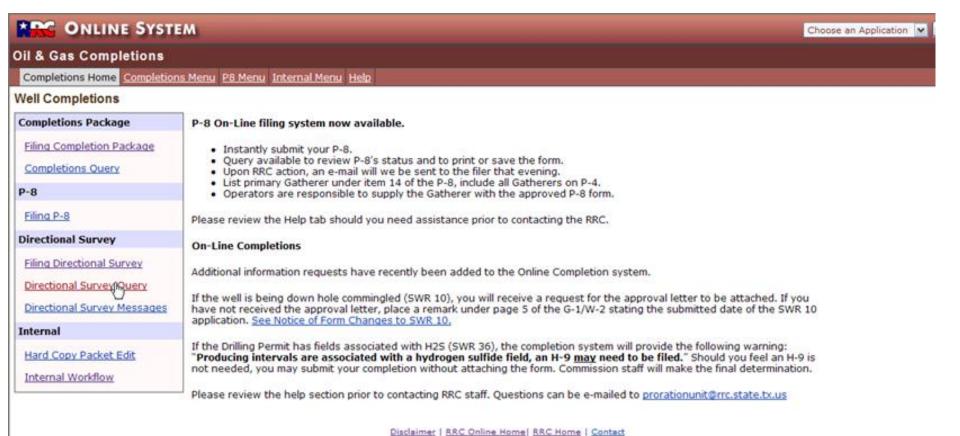


Surveys can be submitted hardcopy through the mail or through the RRC online system.

- Submitted hard copy takes at least two (2) weeks.
- Surveys submitted online are immediately available for review.

Online Submission





Online Submission



il & Gas Completions		
Completions Home Completions Menu P8 Menu Internal Menu Help		
irectional Survey		
Survey Company: STEVENS GAS COMPANY (819560)		
Directional Survey Data		·
Operator Name: LEWIS PETRO PROPERTIES, INC. (499978)	RRC District No.: 04	
Field Name: OWEN (OLMOS)	County: WEBB	
Lease Name: NORTHEAST COMPLEX	Well No.: 2H	
API No.: 479-41167	RRC Gas ID or Oil Lease No.:	
Drilling Permit No: 708526		
Upload Directional Survey		
Survey Type: -Select One-	Browse	
Depth Interval From: feet Depth Interval	al To: feet Lateral Label: -Select One- M	
Survey Start Date: MM/DD/YYYY Survey End Da	ate: MM/DD/YYYY	
Type Other Remarks:		
	^	
Upload Clear		
* The current limit on files being uploaded is 6MB.		
Current Attachments		
Attachment Type Name	From To Label Start Date	End Date
Additional Information		
Remarks:		
	<u> </u>	
Certification I declare under penalties prescribed in Sec. 91.143, Texas Natural Resources that data and facts stated therein are true, correct, and complete, to the bes	s Code, that I am authorized to make this report, that I prepared or supervise st of my knowledge.	ed and directed this report, and
I accept: ⊙ No ○ Yes		
Save Certify Return To Results		

Online Query

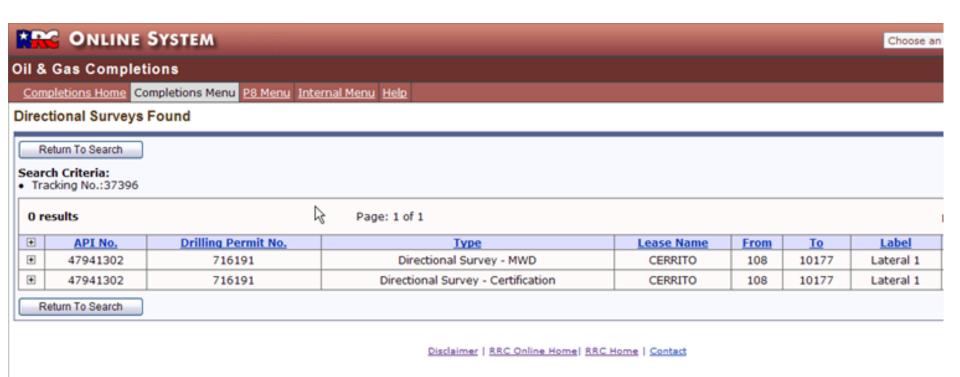


Gas Completions Indicate the completions Menu P8 Menu Internal Menu Help	
ctional Survey Query	
Tracking No.:	
Certified Date From:	Or
Certified Date To:	MM/DD/YYYY
API No.:	
Survey Company No.:	Search Survey Company
Drilling Permit No.:	
Type:	-Select One-
Depth:	
Hard Copy Entered Date From:	Or MM/DD/YYY
Hard Copy Entered Date To:	MM/DD/YYYY
Search Clear Find	Hard Copy Surveys w/o Images Find Unused Certified Surveys Find Unused Uncertified Surveys
	Trade dopy durings and integer
Messages Recent Notifications	
Messages	

Online Query



Search online by API number to verify submission



Presentation Overview



Introduction
Survey Requirements
Submission Procedures
Engineering Review

Presentation Overview



Introduction
Survey Requirements
Submission Procedures
Engineering Review

Engineering Review



Survey completeness

- Tie-ins
- Certification

Well construction

- Wellbore profile
- Abandoned wellbore
- Required plugs and cementing

Spacing

- Lease line spacing
- Between-well spacing
- Permitted location
- NPZs

Survey Completeness: Tie ins



- RRC will accept specific combinations of surveys that represent a complete picture of the entire wellbore.
- All surveys must tie in at given depths with identical X,Y, and Z coordinates.

Eng Review: Tie-Ins



Survey A (GYRO)

Depth	Incl.	Azimuth	+N/-S	+E/-W	Tool
600'	2.3	270°	5	20	GYRO
800′	3.3	268°	9	-80	GYRO

Survey B (MWD)

Tie-in point

Depth	Incl.	Azimuth	N-S	E-W	Tool
800′	3.3	268°	9 N	80 W	GYRO
1000	10	272°	15 N	120 W	MWD

We will contact you if the tie-in data are missing.

Eng Review: Certification



Attachments page of the G-1 or W-2

Certified Directional Surveys				
Attachment Type	Name	From	To	
Gyro	728663714.pdf	0	2205	Attach to Packet
MWD	RVB No 20 Survey Letter.pdf	2243	9900	Attach to Packet
MWD	Rosa V Benavides 20H ST1 Survey Letter.pdf	2205	10300	Attach to Packet
Certification	RVB No 20 Certified Letter.pdf	2243	9900	Attach to Packet
Certification	rosa v benavides 20h-laredo-2205=071.pdf	0	2205	Attach to Packet
Certification	Rosa V Benavides 20H ST1 Certified Letter.pdf	2205	10300	Attach to Packet

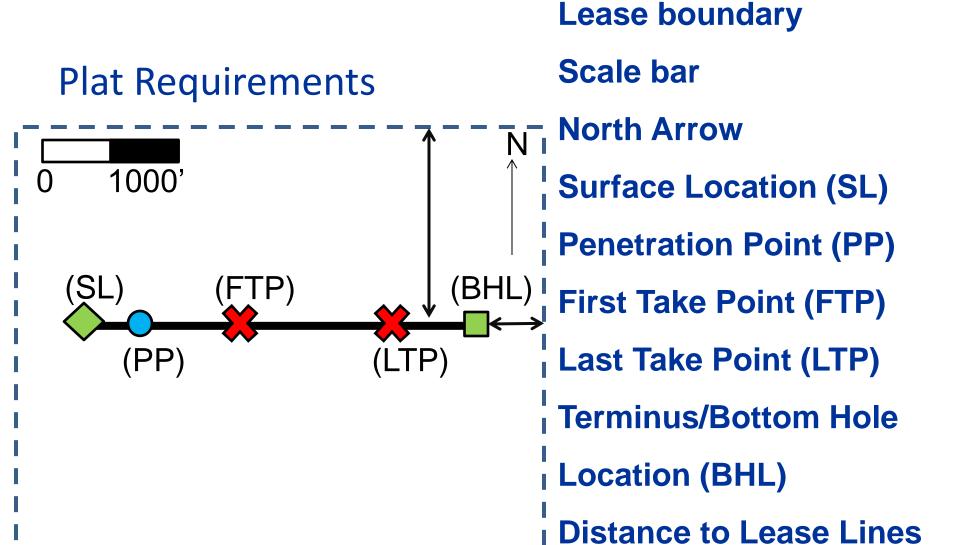
Engineering Review



Wellbore Construction:

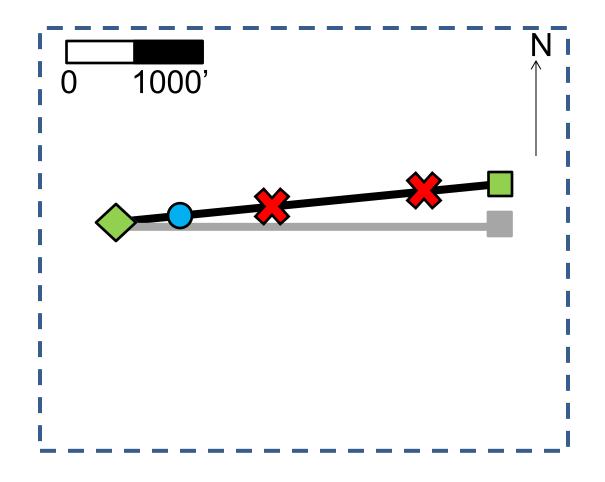
- Compiled from inclination and directional surveys
 - SWR 11 requires ALL directional surveys
- Well location projected onto Permit Plat
- Permit and As-drilled plat requirements follow





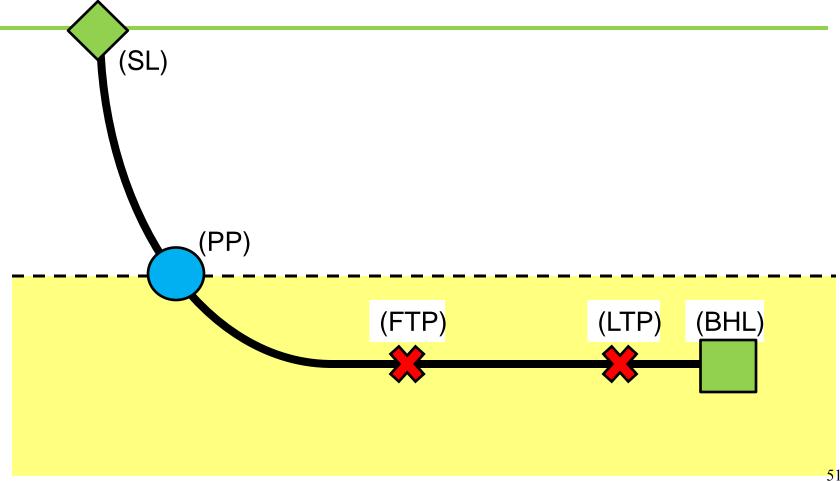


Permit Location As-drilled Location





Wellbore construction





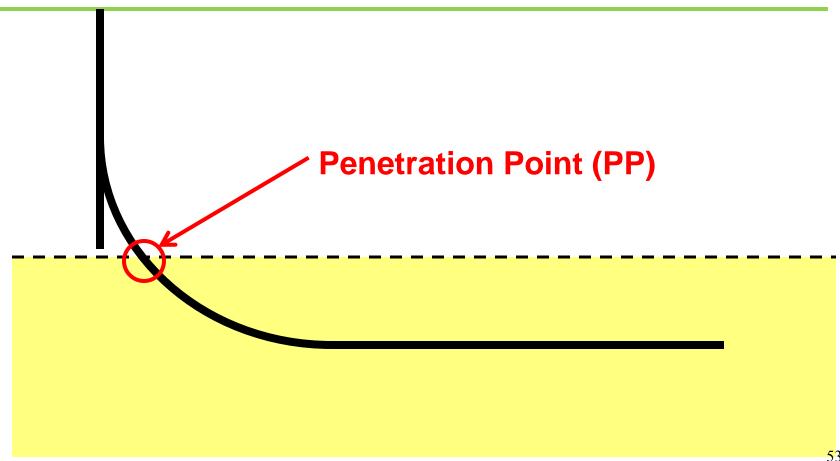
Sometimes directional surveys indicate abandoned sections of wellbore (pilot holes or sidetracks) that must be plugged.



District Offices don't necessarily review directional surveys, so it is crucial to communicate any intentions to abandon portions of the wellbore with the District Offices directly and in advance.

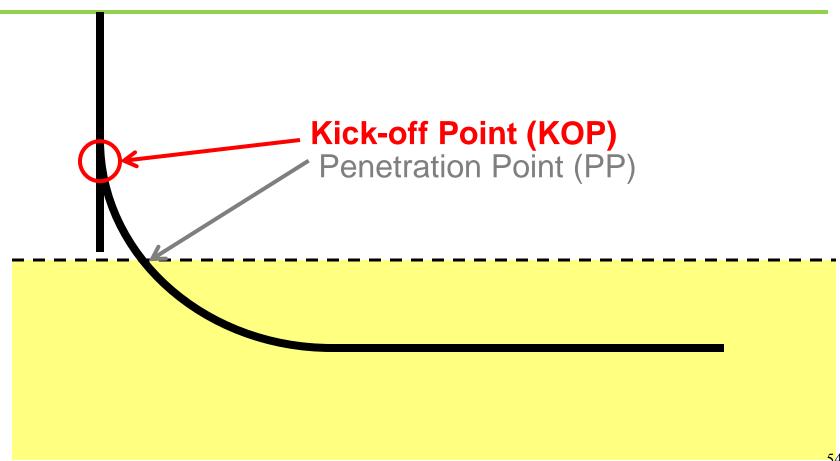


Wellbore construction

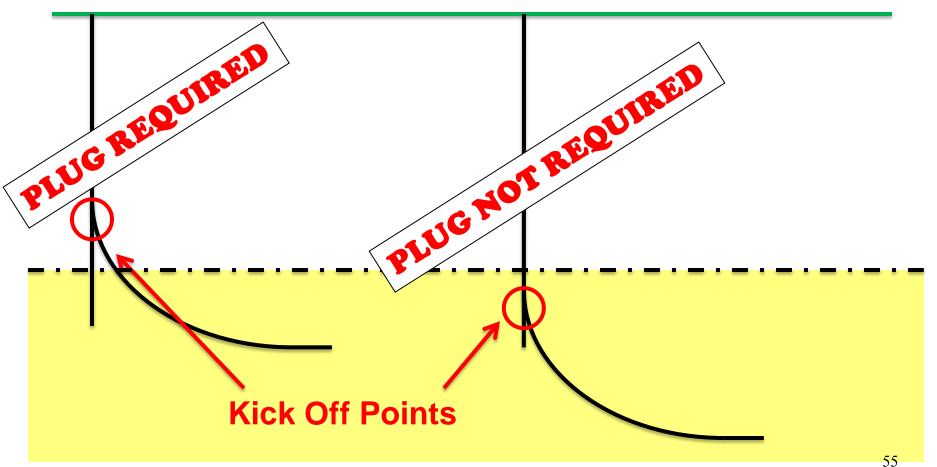




Wellbore construction







Statewide Rule 3.14 (SWR 14)



Outlines Cementing and Plugging Requirements

Purpose: To isolate and protect usable water and productive formations from migration and contamination

- *Minimum plug dimensions*:
- 100' thick, centered on penetration point
- Additional 10' required for each 1000' TVD.

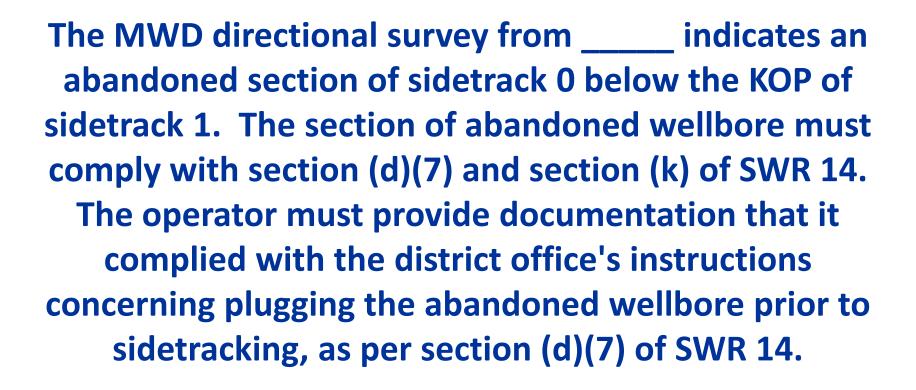


CEMENTING TO PLUG AND ABANDON	PLUG # 1
23. Cementing date	
24. Size of hole or pipe plugged (in.)	
25. Depth to bottom of tubing or drill pipe (ft.)	
26. Sacks of cement used (each plug)	
27. Slurry volume pumped (cu. ft.)	
28. Calculated top of plug (ft.)	
29. Measured top of plug, if tagged (ft.)	
30. Slurry wt. (lbs/gal)	12.0
31. Type cement	

Form: W-15

- Plugging record on page 2
- Used to calculate plug thickness

Eng Review: Abandoned Sections





SWR 14

- (j) "The district director or the director's delegate shall review and approve the notification of intention to plug in a manner so as to accomplish the purposes of this section."
 - Exceptions may be granted by district offices, not Austin
 - Note Job# of communication/notification with District in the remarks section of W-2/G-1

SWR 14 Exceptions

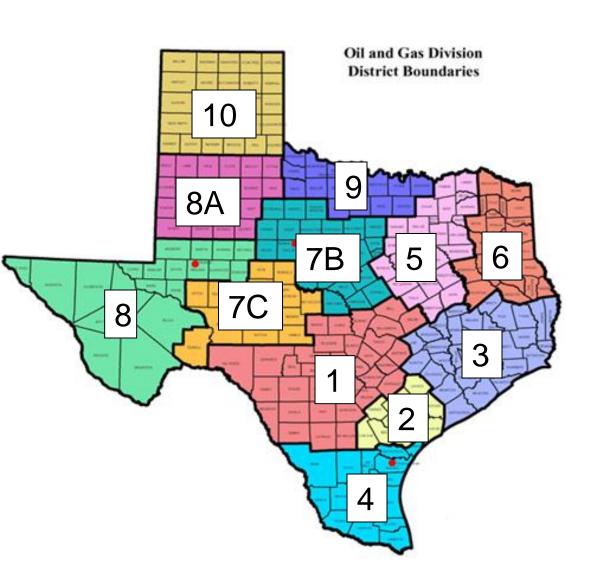


1. Contact District Office:

- ✓ Acknowledge/advise of SWR 14 violation
- ✓ Explain circumstances of violation
- ✓ Make a case for adequate isolation
- ✓ Formally request an exception to the rule
- 2. Forward District Office response to Engineering
 - ! Letter from operator to District may not resolve issue
- ➤ Repeat violations may result in recommendation for administrative penalty action

SWR 14 Exceptions





Oil and Gas Division District Offices:

Abilene

Corpus Christi

Houston

Kilgore

Midland

Pampa

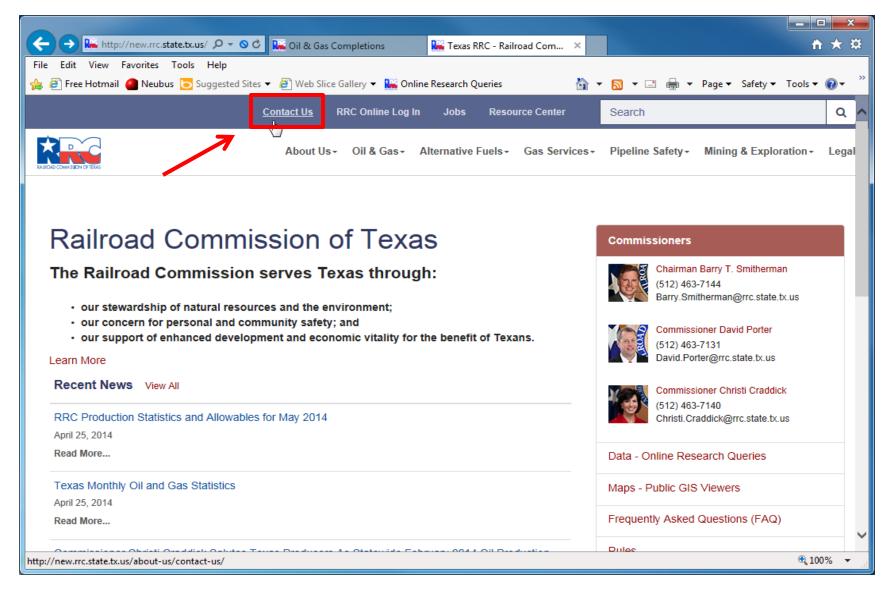
San Angelo

San Antonio

Wichita Falls

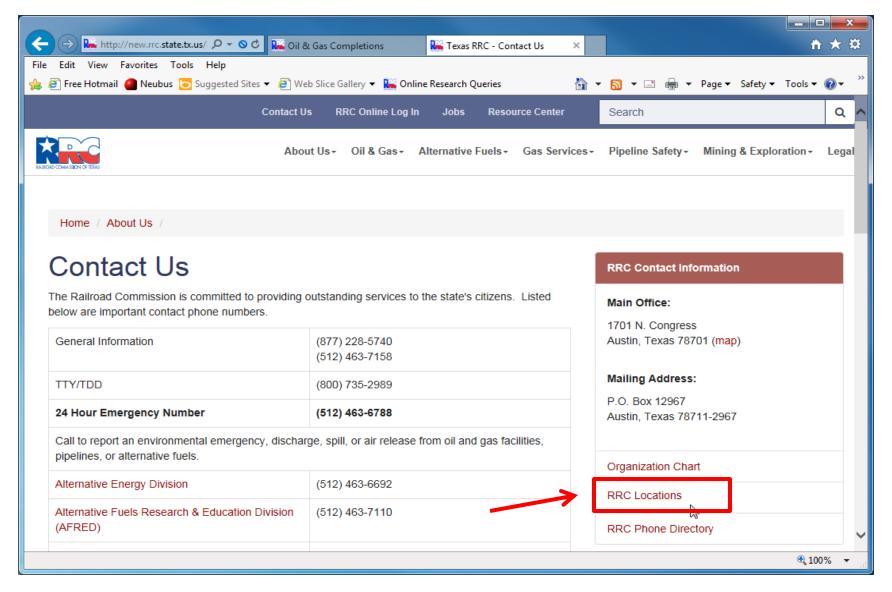
District Office Contact Info





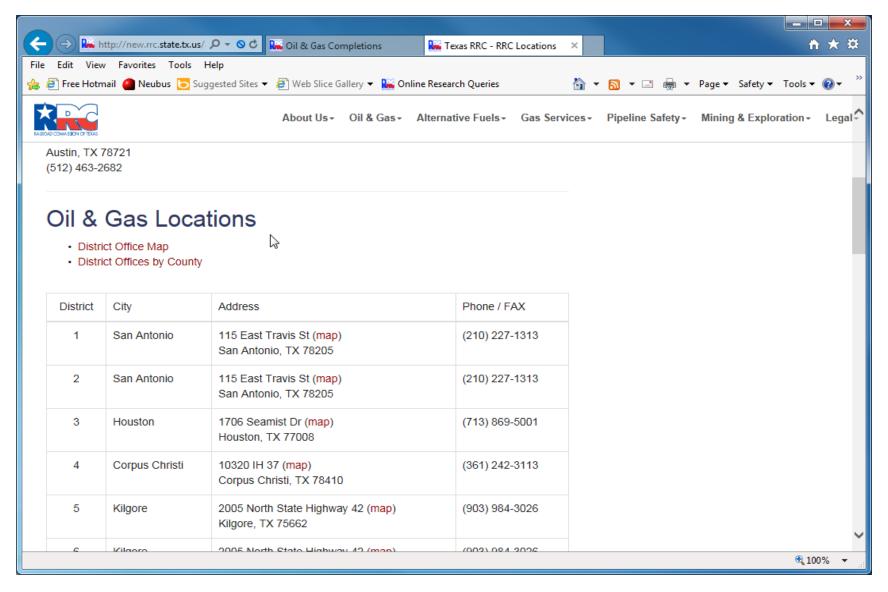
District Office Contact Info





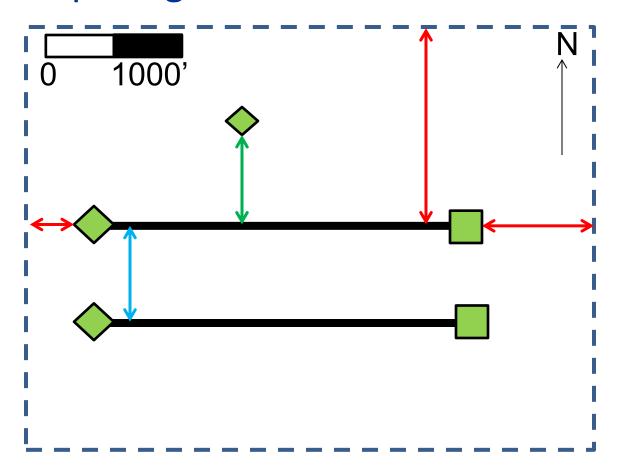
District Office Contact Info







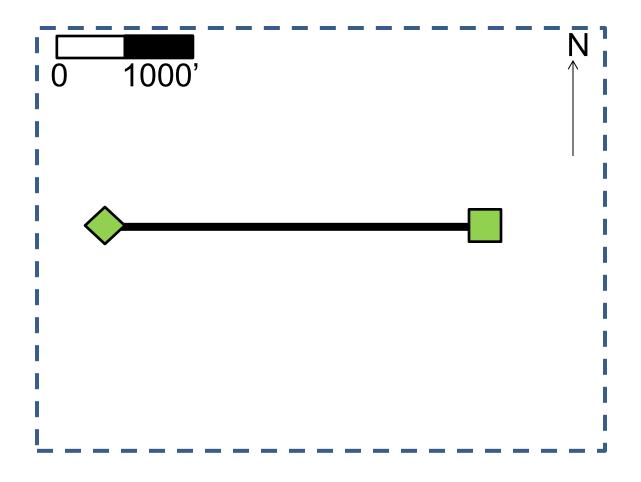
Spacing concerns



Lease Line Spacing
Between-well
spacing (horizontal
wells)
Between-well
spacing (vertical
wells)

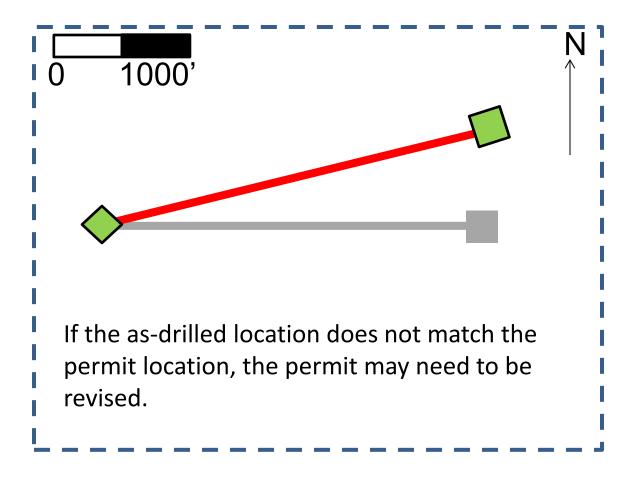


Permitted Location



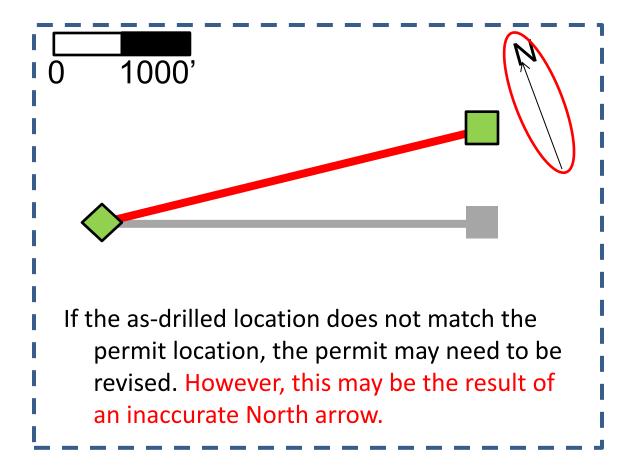


Permitted As-Drilled Location



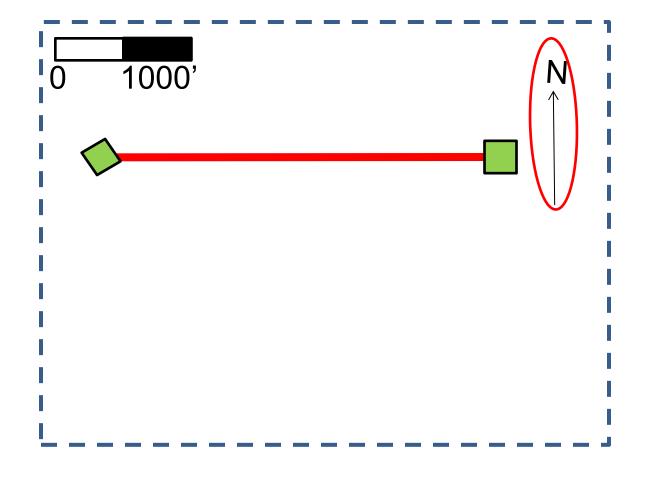


Permitted As-Drilled Location



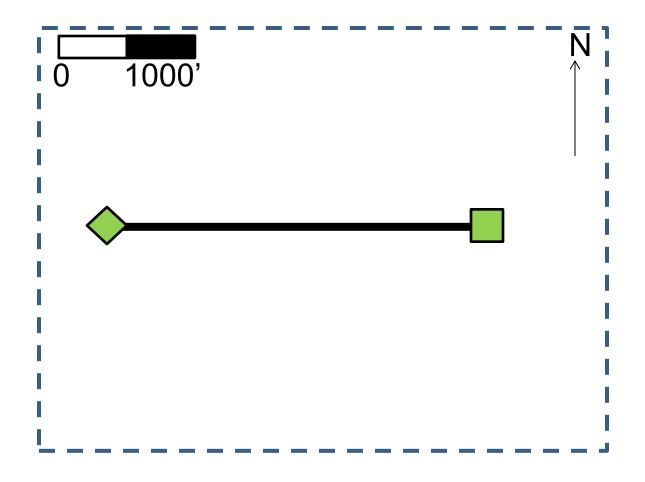


Permitted As-Drilled Location



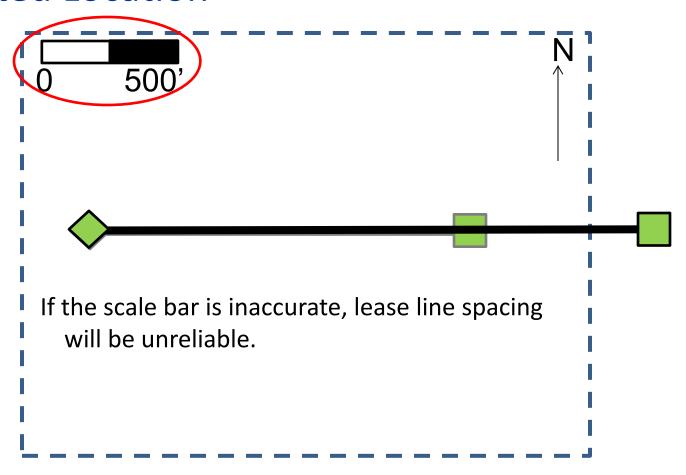


Permitted Location





Permitted Location



Engineering Review



Online messages

- Attached if an issue arises
- Dispatched at the end of the day
- No notification is sent when an operator responds, email to notify us directly for rapid response
- Otherwise, we go through all old messages periodically, takes a few days depending on reviewer.



Special Field rules are tailor made rules approved by the Commission for various fields.

There are a couple common rules that are seen in various fields. Here are a few:

- Lease Line spacing
- Well Spacing
- Off lease penetration points
- Box rule
- Heel & Toe Provisions

RAILROAD COMMISSION OF TEXAS HEARINGS DIVISION

OIL AND GAS DOCKET NO. 02-0282092 IN THE EAGLEVILLE (EAGLE FORD-2) FIELD, DE WITT, KARNES, LAVACA AND LIVE OAK COUNTIES, TEXAS

FINAL ORDER

AMENDING THE FIELD RULES FOR THE EAGLEVILLE (EAGLE FORD-2) FIELD DE WITT, KARNES, LAVACA AND LIVE OAK COUNTIES, TEXAS

The Commission finds that after statutory notice in the above-numbered docket heard on June 13, 2013, the presiding examiner has made and filed a report and recommendation containing findings of fact and conclusions of law, for which service was not required; that the proposed application is in compliance with all statutory requirements; and that this proceeding was duly submitted to the Railroad Commission of Texas at conference held in its offices in Austin, Texas.

The Commission, after review and due consideration of the examiner's report and recommendation, the findings of fact and conclusions of law contained therein, hereby adopts as its own the findings of fact and conclusions of law contained therein, and incorporates said findings of fact and conclusions of law as if fully set out and separately stated herein.

Therefore, it is **ORDERED** by the Railroad Commission of Texas that the Field Rules adopted in Final Order No. 02-0266475, effective November 30, 2010, as amended, for the Eagleville (Eagle Ford-2) Field, De Witt, Karnes, Lavaca and Live Oak Counties, Texas, are hereby amended. The amended Field Rules are set out in their entirety as follows:



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Railroad Commission of Texas Mission Statement

The Railroad Commission serves Texas through:

- · our stewardship of natural resources and the environment;
- · our concern for personal and community safety; and
- our support of enhanced development and economic vitality for the benefit of Texans.

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Recent News View All

Railroad Commissioner David Porter Tours Westmoreland Jewett Mine

April 29, 2015

Railroad Commissioner David Porter today toured the Texas Westmoreland Coal Company Jewett Mine, a 35,000acre surface mine complex located between Dallas and Read More...

Texas Coal Production Increases in 2014-Production up by More than One Million Tons

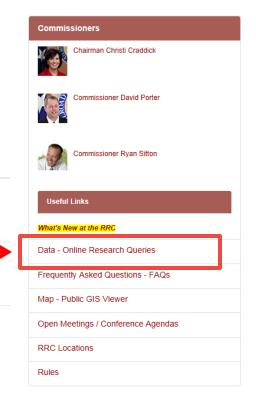
April 28, 2015

The Railroad Commission of Texas reports Texas coal production increased by 2.8 percent in calendar year 2014 over the previous year by 1,184,287 tons for a total Read More...

RRC PRODUCTION STATISTICS AND ALLOWABLES FOR MAY 2015

April 27, 2015

The Texas average rig count as of April 17, was 411, representing about 45 percent of all active land rigs in the United States according to Baker Hughes Incorporated. The Railroad Commission of Texas (Commission) reports that in the last 12 months, total Texas reported production was 930 million barrels of oil and 8.3 trillion cubic feet of natural gas Read More...







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Online Research Queries

The links in the boxes allow users to research oil & gas production, drilling permits, well records, gas utility and pipeline information, surface coal/lignite mining permit information and other related queries.

Note: The online research queries are intended for use by individuals needing specific information from the Railroad Commission of Texas. The use of automated tools to retrieve volumes of data can cause severe degradation of Railroad Commission of Texas systems. If the query system detects that data is being retrieved using an automated tool, the Railroad Commission of Texas will end the session for that user.

Requirements for Accessing Online Research Queries

The Railroad Commission of Texas recommends accessing the online research queries using a broadband Internet connection (Cable Modem, DSL, Fiber, Wireless, Satellite are common examples). A dial-up connection may work, but performance will not be desirable.

Adobe Acrobat Reader 9.5 or higher should be used AND one of the following browsers:

- · Microsoft Internet Explorer 10 or higher
- · Mozilla Firefox 10 or higher
- · Google Chrome 20 or higher
- · Apple Safari 5 or higher

Oil & Gas

Type of Query		
Completions Query		Launch application
Drilling Permit (W-1) Query		Launch application
Electronic Document Management System	Learn more	Launch application
Field Rules Query		Launch application

Important Disclaimer

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Select a Query System to search:

Oil & Gas

Natural Gas Services

Pipeline Safety

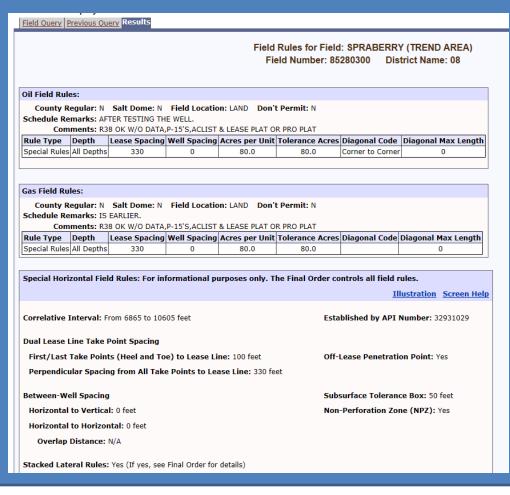




ricid Scarcii		
Search Again		
Search for a Field	Degining with these tharacters opin	ab Search sase enter at least 3 characters
Field Query Resul	its ne following list to view Field Rules.	Fie
85279200 7C SPRA 85279201 7C SPRA 85279400 7C SPRA	BERRY (TREND AREA) BERRY (TREND AREA) R 40 EXC BERRY (TREND AREA CL. FK.)	116
85279800 7C SPRA 85280200 08 SPRA 85280300 08 SPRA	BERRY (TREND AREA)	Oil
85280400 08 SPRA	BERRY (TREND AREA) R 40 EXC BERRY (TREND AREA CL. FK.) BERRY (TREND AREA DEAN-WLFCP)	Sc Rt Sp

Field Coarch

This search function shows the key information about the field rules as well as a link to the docket





http://www.rrc.texas.gov/legal/hearingsand-dockets/dockets/oil-gas-proposals-fordecision-and-orders/



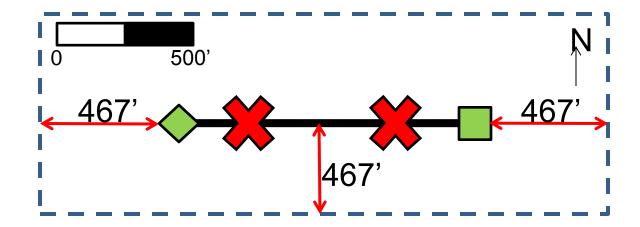


http://www.rrc.state.tx.us/legal/hearingsand-dockets/dockets/oil-gas-proposals-fordecision-and-orders/

Enforcement Actions, Unprotested (Master Defe	ault Orders)
Field Balancing	
Field Consolidation	
Field Rules, Adopted (New, Amended and Tem	nporary)
Maximum Efficient Rate (MER) of Production	\$
Mineral Interest Pooling Act	
Miscellaneous	
Overproduction, Cancellation of	
P-4, Cancellation of (Severance of Lease)	
Productive Acreage	
Proper Operator	



Default Statewide Spacing rules: 467' Lease Line and 1200' Between-Well

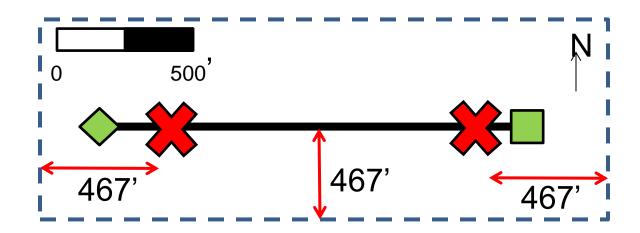




Take-Point Provisions



Take-Point Provisions allow longer drainhole length. Spacing is measured to the take points instead of the SHL and terminus

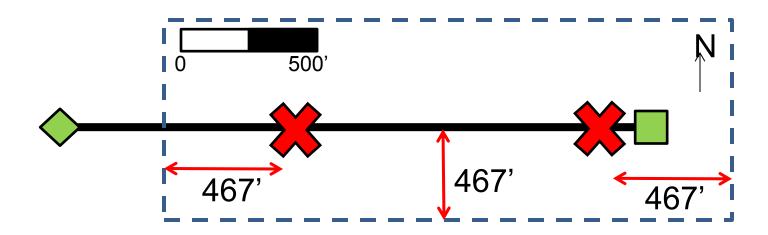




Off-lease Penetration Points



Off-lease penetration points enable operator to have surface-hole and penetration points outside of lease

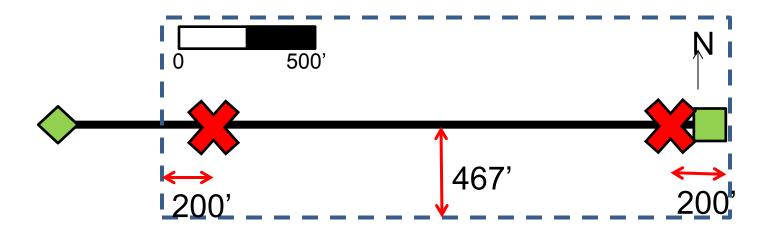




Heel and Toe Provisions



Heel and Toe Provisions reduce spacing requirements measured from take points, parallel to the drainhole



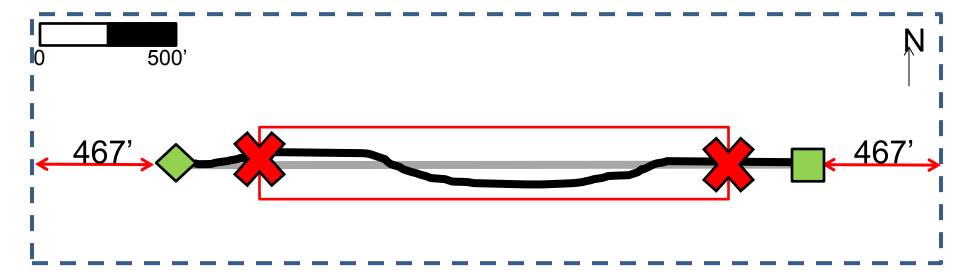


Box/Rectangle Rule



Gives operators extra leeway in drilling wellbores. A box is created around the proposed FTP and LTP, widths depend on the specific field rules.

As long as the wellbore stays in the box, it is compliant.





Common Online Messages



Problem

Solution

Correct and resubmit Plat Incomplete Directional survey(s) lacking Directional survey(s) missing Search online query, contact Wrong Directional Survey surveyor Invalid tie-in points Certification lacking Have surveyor correct cert. letter **Double-certification** SWR 14 violation **Contact District Office Off-lease Terminus** Check scale bar and North Lease-Line Violation arrow (on plat), amend Between-well Spacing violation permit if necessary Well location doesn't match Plat

In Summation



Know your required surveys.

Certify and Submit accordingly.

Remarks are helpful.

Special Field Rules are your friend.

Take-Point Provisions

Off-Lease Penetration

Heel/Toe Provisions

Rectangle Rules

As-Drilled Plat requirements

For best results: contact your Engineering Specialist directly in addition to responding to Online Messages.

Contact Information



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Questions?





FAQs



- Q: In the vertical section of a horizontal well, what is the directional survey shot point spacing?
- A: The shot point spacing is always 200 feet or less for all directional survey in all cases.
- Q: If the "correlative interval" is penetrated off-lease but the well is only perfed at a legal location, what does the operator need to do?
- A: By statewide default rules, the well is *not allowed* to penetrate the correlative interval off-lease. However, in some fields special field rules do allow for off-lease POP. Operator is required to serve 21-day notice to the offset mineral owner. (check special field rules)
- Q: If special field rules authorize an off-lease penetration point, can the terminus be drilled off-lease?
- A: This provision *does not* allow the terminus to be off-lease.